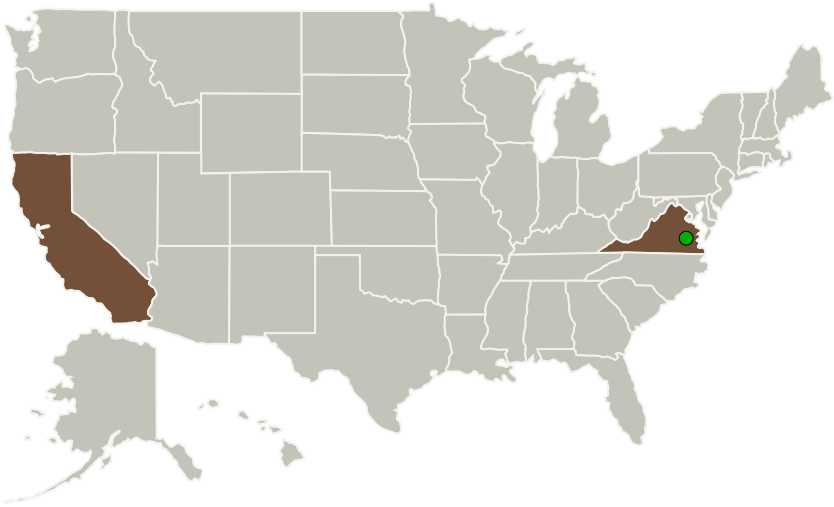
# Thermal Protection Systems Nondestructive Evaluation Tool, Phase II

Completed Technology Project (2015 - 2017)

## Project Introduction

Based on the successful feasibility demonstration in Phase I, Physical Optics Corporation (POC) proposes to continue the development of a novel Thermal Protection System Nondestructive Evaluation Tool (THRON), which addresses NASA's need for evaluation of lightweight rigid and/or flexible ablative materials, and provides noncontact, one-sided in situ operation for accurate detection, identification, and precise spatial localization and measurements of internal and surface defects/voids, and evaluation of bondlines and in-depth integrity of such materials and also large-area multilayer thermal protection system (TPS) structures with complex geometries. THRON is based on POC-patented X-ray Compton imaging tomography and POC-patented apodized coded aperture X-ray imaging optics, substantially modified and optimized to meet NASA's requirements. The THRON Phase I prototype demonstrated excellent potential for detection and spatial localization of defects/voids with dimensions <6 mm by 6 mm by 6 mm, and bondline defects <12 mm by 12 mm by 200 μm in TPS material and structures. At the end of Phase II, POC will perform a technology readiness level (TRL)-6 demonstration of THRON in POC's X-ray lab and/or at NASA facilities, and will deliver to NASA a working engineering model of an effective NDE tool.

## Primary U.S. Work Locations and Key Partners

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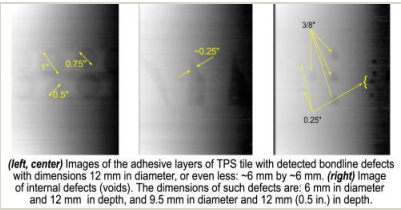
| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| Physical Optics Corporation | Lead Organization | Industry | Torrance, California |
| Langley Research Center(LaRC) | Supporting Organization | NASA Center | Hampton, Virginia |

| Primary U.S. Work Locations | |
|---|---|
| California | Virginia |

## Images




***(left, center)*** Images of the adhesive layers of TPS tile with detected bondline defects with dimensions 12 mm in diameter, or even less: ~6 mm by ~6 mm. ***(right)*** Image of internal defects (voids). The dimensions of such defects are: 6 mm in diameter and 12 mm in depth, and 9.5 mm in diameter and 12 mm (0.5 in.) in depth.

**Briefing Chart**
Thermal Protection Systems Nondestructive Evaluation Tool Briefing Chart
*(https://techport.nasa.gov/image/134098)*

## Organizational Responsibility

**Responsible Mission Directorate:**
Space Technology Mission Directorate (STMD)

**Lead Organization:**
Physical Optics Corporation

**Responsible Program:**
Small Business Innovation Research/Small Business Tech Transfer

## Project Management

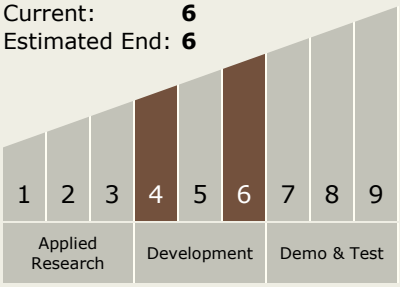
**Program Director:**
Jason L Kessler

**Program Manager:**
Carlos Torrez

**Principal Investigator:**
Naibing Ma

## Technology Maturity (TRL)

Start: **4**
Current: **6**
Estimated End: **6**



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## Technology Areas

**Primary:**

- TX09 Entry, Descent, and Landing
  - TX09.4 Vehicle Systems
    - TX09.4.5 Modeling and Simulation for EDL

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System